

REMARKS

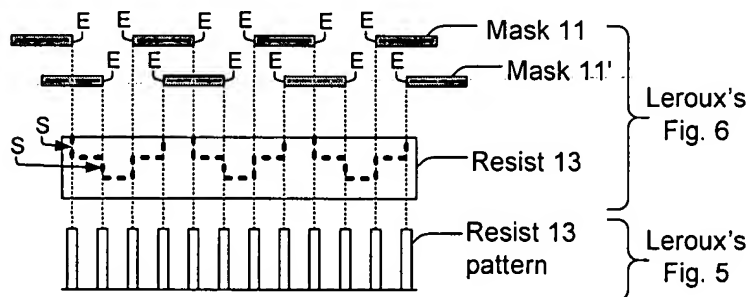
Claims 1-14 were pending in the application and were rejected under 35 U.S.C. 103 over Leroux (U.S. patent 5, 407, 785).

Claim 1 recites two operations, (a) and (b), of irradiating a material sensitive to radiation. The material is formed on a substrate. Claim 1 is amended to recite that when the material is developed, the resulting "pattern of the exposed and unexposed portions of the substrate ... reproduces the pattern of the clear and non-clear regions of the first mask" (the mask used in operation (a)).

In Leroux, the pattern of the exposed and unexposed portions of the substrate (see Leroux's Fig. 5) does not reproduce the pattern of the clear and non-clear regions of any one of his masks 11, 11' (Fig. 6). Instead, the pattern of Leroux's Fig. 5 is defined by the edges of the clear and non-clear sub-regions of the masks 11, 11', as illustrated in the following diagram A and explained below:

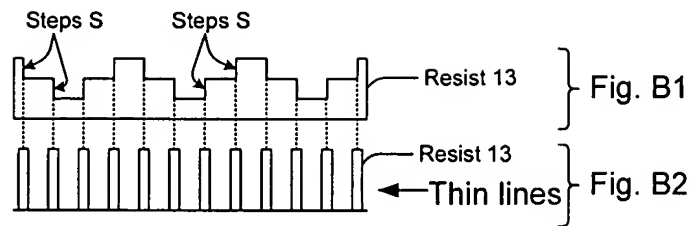
DIAGRAM A

E = Edge of non-clear sub-region
S = step in resist



Each edge E in the masks 11, 11' produces a step S in resist 13 during the partial bleaching of the resist layer, as shown in diagram A. See also Leroux's Figs. 3 and 4 and the following diagram B, Fig. B1:

DIAGRAM B



During the subsequent blanket exposure of the resist (Leroux's Fig. 4), the steps S lead to the formation of a thin line under each step (diagram B, Fig. B2). See Leroux's Fig. 5 and column 3, lines 36-47, stating:

... when the partially beached wafer of FIG. 2 is developed, a stair-step pattern is produced in the photoresist layer ... Each of the steps is used to produce a thin line of resist underneath the step ... During blanket exposure, the stepped profile of the photoresist layer causes exposure in the vicinity of surface steps to be retarded. Development of the photoresist then produces thin lines of resist underlying the steps...

The thin lines are produced either as a result of a phase shift occurring at each step during the blanket exposure, or as a result of a "shadowing mechanism" (Leroux, column 3, lines 48-59).

Leroux does not teach or suggest using at least two exposures to reproduce a pattern on a mask used in one of the exposures as recited in Claim 1.

Claims 2-7 depend from Claim 1.

Claim 8 also depends from Claim 1, and recites that "the clear region of the first mask comprises two clear sub-regions separated by a non-clear gap, and the clear region of the second mask covers the position of the non-clear gap".

Claim 8 is supported by Applicant's Figs. 4 and 6. In the mask of Fig. 4, the clear region includes two clear sub-regions 410M separated by a gap 430M. In Fig. 6, the clear

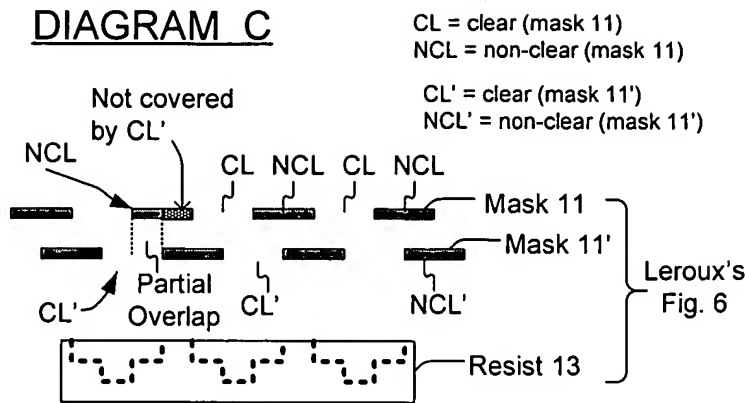
regions 610 cover the positions of gaps 430M. One advantage of this design is counteracting a possible resist underexposure at the ends of rectangles 410M near the gaps 430M when the resist is exposed with the mask of Fig. 4. Other advantages are explained on page 5, lines 1-2. Of note, the exposure through the mask of Fig. 6 does not destroy the resist pattern defined by the mask of Fig. 4 because the exposure through the mask of Fig. 6 is conducted with a dose insufficient to remove the resist in the developing step and expose the substrate (Applicant's specification, page 4, lines 11-12). This corresponds to the recitation in Claim 1, paragraph (b), indicating that the radiation dose for the second mask of Claim 8 "is insufficient by itself to enable the developing operation to create a pattern with a portion of the substrate exposed and a portion of the substrate not exposed".¹

Leroux teaches an exposure through mask 11 (Fig. 1), an exposure through mask 11' (Fig. 2), and a blanket exposure (Fig. 4). The blanket exposure has enough energy to create a pattern of exposed and unexposed regions on the substrate (the pattern in Fig. 5). Therefore, the blanket exposure does not meet the "second mask" requirements of Claim 8 (see Claim 1, paragraph (b)).

The exposures through the masks 11, 11' also do not meet the second mask requirements, and in particular the requirement that the clear region of the second mask is to cover the position of a non-clear gap in the first mask. Leroux's mask 11 has clear regions CL (see Diagram C below) separated by non-clear gaps NCL. Mask 11' has clear regions CL' and non-clear gaps NCL'. The clear regions CL' do not cover the positions of any non-clear gap NCL as recited in Claim 8. The clear regions CL' only partially overlap the positions of the non-clear gaps NCL. Similarly, the clear regions CL do not cover the positions of a non-clear gap NCL'.

¹ The claims are not limited to the embodiments or advantages discussed herein and in the application.

DIAGRAM C



Moreover, Leroux uses this particular design to form some of his steps S (diagram B above, Fig. B1). In other words, some of the steps are formed because each non-clear gap of one mask has a portion whose position is not covered by the clear region of the other mask. Therefore, Leroux teaches away from Applicant's invention.

Claim 9 depends from Claim 1, and further recites that "the second mask is clear at each position at which the first mask is clear". This recitation is supported by Applicant's Figs. 4 and 6. The mask of Fig. 6 is clear at each position at which the mask of Fig. 4 is clear.

Leroux's masks 11, 11' do not meet the language of Claim 9.

Leroux's blanket exposure of Fig. 3 also does not meet the conditions of Claim 9 because Claim 9 requires the irradiation through the second mask to be with an energy dose "insufficient by itself to enable the developing operation to create a pattern with a portion of the substrate exposed and a portion of the substrate not exposed" (see Claim 1, paragraph (b)).

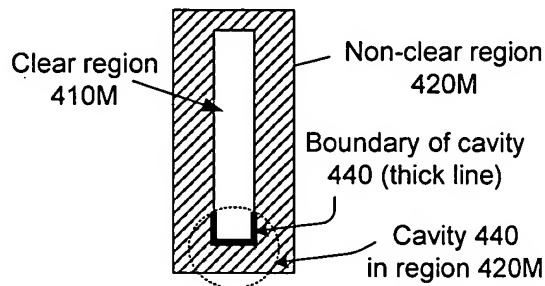
Claims 10-13 depend from Claim 1.

LAW OFFICES OF
MacPherson Kwok
Chen & Heid LLP

1762 Technology Drive
Suite 226
San Jose, CA 95110
Telephone (408) 392-9250
Fax (408) 392-9262

Claim 14 also depends from Claim 1, and recites that “the clear region of the second mask covers a position of the clear region of the first mask”. See the discussion above in connection with Claim 9.

New Claim 15 depends from Claim 1. Claim 15 is supported by Applicant’s Figs. 4 and 7. The non-clear region 420M of Fig. 4 has cavities 440 formed at the ends of clear rectangles 410M. Each cavity 440 has a non-straight boundary adjacent to the corresponding clear region 410M:



The non-straight boundary line is covered by the mask of Fig. 7. This design counteracts a possible resist underexposure adjacent to the boundary.

Leroux does not teach or suggest this invention.

New Claim 16 recites a non-straight boundary (see the last paragraph of Claim 16), and is believed to be allowable for reasons similar to the reasons given above for Claim 15.

New Claim 17 is believed to be allowable for reasons similar to the reasons given above for Claim 8 (“gap”).

New Claim 18 is supported by Applicant’s Figs. 4 and 6. The “array of elongated sub-regions” in paragraph (a) of Claim 18 reads on the array of rectangles 410M. The “strips” read on strips 610.

Leroux does not disclose the mask design of Claim 18, and provides no motivation therefor.

Any questions regarding this case can be addressed to the undersigned at the telephone number below.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 28, 2003.

Michael Shenker 8-28-03
Attorney for Applicant(s) Date of Signature

Respectfully submitted,

Michael Shenker

Michael Shenker
Patent Attorney
Reg. No. 34,250
Telephone: (408) 392-9250

Law Offices Of
MacPherson Kwok Chen & Heid LLP
1762 Technology Drive, Suite 226
San Jose, CA 95110

LAW OFFICES OF
MacPherson Kwok
Chen & Heid LLP
1762 Technology Drive
Suite 226
San Jose, CA 95110
Telephone (408) 392-9250
Fax (408) 392-9262